SYMBIOTIC STARS IN THE MAGELLANIC CLOUDS

Joanna Mikołajewska[1]

RESUMEN

El resumen será traducido al español por los editores. Orbital periods and other parameters of symbiotic binary systems in the LMC and SMC are presented and discussed. In particular, the symbiotic stars in the MCs are compared with those in the Milky Way.

ABSTRACT

Orbital periods and other parameters of symbiotic binary systems in the LMC and SMC are presented and discussed. In particular, the symbiotic stars in the MCs are compared with those in the Milky Way.

Key Words: **MAGELLANIC CLOUDS — STARS: SYMBIOTIC — STARS: BINARY SYSTEMS — STARS: PARAMETERS**

Symbiotic stars are long-period interacting binary systems in which an evolved giant star (normal giant in S-types, and Mira variable surrounded by thick dust envelope in D-types, respectively) transfers material to its much hotter compact companion. Such a composition places them among the intrinsically brighest variable stars that can be easily detected in nearby galaxies, in particular in the Magellanic Clouds (MC). At present the number of confirmed symbiotics is at 6 in the SMC and 8 in the LMC (e.g. Belczyński et al. 2000). Here, I present and discuss some physical parameters of MC symbiotic stars derived from available observational data, in particular, those contained in MACHO, 2MASS, IUE and HST databases.

The MACHO/OGLE II light curves of SMC 3 have been recently discussed by Kahabka (2004) who found evidence for $\sim 1600^{\rm d}$ orbital modulation, in addition to $110^{\rm d}$ pulsation of the M0 giant component. The MACHO light curves for LMC systems, S63, N19 and S147 are shown in Figure 1 together with the corresponding power spectra. In all cases there is a strong periodicity of the order of $1000^{\rm d}$, which can be due to orbital motion. For LMC N19, strong variability in U light was reported by Morgan (1996) who also gave dates both when the star was was faint and bright. Combining this information with our light curves, we find that epochs of relative faintness reported by Morgan and the deep minima in the light curves follow the ephemeris: MJD Min $= 50\,632 + 946 \times$ E. Similarly, the IUE fluxes in LMC S63 observed in 1982 (maximum of the $1060^{\rm d}$ periodicity) are higher than those in 1994 (ingres) as expected for orbital modulation. For

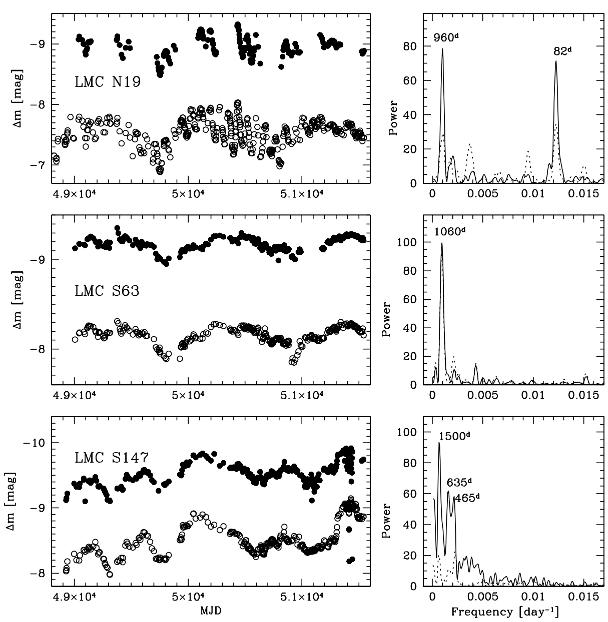

Fig. 1. MACHO light curves for LMC N19 (top), LMC S63 (middle), and LMC S147 (bottom), and the corresponding power spectra. The blue and red channel data are plotted as open and filled circles (light curves), and solid and dashed lines (periodograms), respectively.

LMC S147, the situation is more complicated, and additional observations (U photometry and/or spectroscopy) are needed to confirm orbital origin of the modulation visible in its light curves. In N19 there is also strong periodicity at $\sim 80^{\rm d}$ which may be due to radial pulsation of the M4 giant component, similar to that found in SMC 3 (Kahabka 2004).

2MASS colors of MC systems and the H-R diagrams for the red giants are shown in Figure 2a,b. MC systems contain low mass, $\leq 3\,M_{\odot}$, giants as

[1] N. Copernicus Astronomical Center, Warsaw, Poland

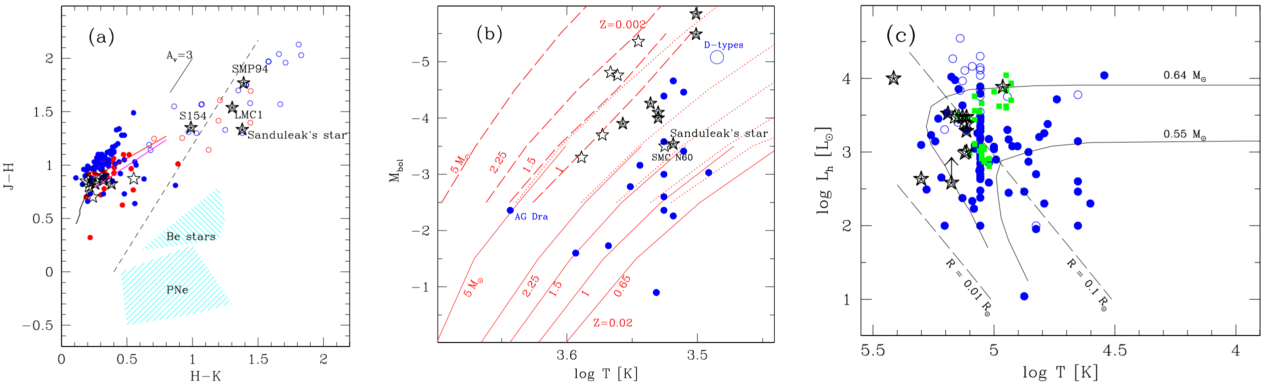

Fig. 2. (a) Color-color diagram for MC symbiotic stars from 2MASS (open stars correspond to the SMC and filled stars to the LMC systems, respectively). For comparison, galactic systems from Munari et al. (1992) and 2MASS are also plotted (closed and open circles represent S- and D-type systems, respectively). The shaded regions denote planetary nebulae (PNe) and Be stars. Full lines mark the locii of luminosity class III stars and LPVs, and dashed line represent black bodies. (b) H-R diagram for the symbiotic giants. Symbols for galactic systems (Mikołajewska 2004; only system with measured red giant radii, and thus with accurate distances, are plotted) and MC systems are the same as in (a). Evolutionary tracks (Hurley et al. 2000) for low mass AGB (dashed) and RGB (solid) stars for different Z are also plotted. Note the position of the very low Z galactic system AG Dra in the region occupied by the SMC systems. (c) H-R diagram for the hot components. Galactic (Mikołajewska 2004) and MC systems (Mürset et al. 1996; this study) are plotted as circles and stars, whereas whereas filled and open symbols represent the S- and D-systems, respectively. Squares correspond to data for AG Dra. Evolutionary tracks for the cooling white dwarfs (Schönberner 1989), and constant radii are plotted as solid and dashed lines, respectively.

do their galactic cousins, however only AGB giants are found in MC systems. Four D-type systems in the LMC of 8 total, wheras no a D-type system in the SMC are found. The later result is surprising because non dusty, S-type galactic systems rarely contain AGB giants. The lack of dusty systems among the SMC symbiotics may reflect the very low Z in the SMC, too low to form enough dust in the giant envelope.

The hot components of the galactic and MC systems overlap in the H-R diagram (Figure 2c) but MC systems are among the hottest and the brightest. This together with the fact that all MC systems contain AGB giants is probably due to that only the brightest symbiotic systems have been detected in the MCs. It is, however notable that the hot component of AG Dra, the galactic symbiotic with the lowest measured $Z \sim 0.002$ is also among the hottest systems. Further studies are necessary to study the effect of metallicity on the symbiotic appearance.

Summarising, the first orbital periods for MC symbiotic systems have been found, all in the range 900–1600 days which is consistent with the longer period tail of galactic S-type systems (Mikołajewska 2003). MC symbiotics are low mass systems as their galactic cousins. Although the MC sample is biased towards the hottest and the brightest systems there is some evidence for nonegligible metallicity effect on the symbiotic phenomenon.

I gratefully acknowledge the financial support from the LOC, IAU, and KBN Research Grant No. 5P03D 019 20. This study made use of the public domain data of the MACHO Project, which was performed under joint auspices of the DOE, NNSA by the U. of Cal., LANL, and the Mt. Stromlo and Siding Spring Obs., and the 2MASS, which is a joint project of the U. of Mass. and the IPAC/Caltech, funded by the NASA and the NSF.

REFERENCES

Belczyński, K., Mikołajewska, J., Munari, U., Ivison, R.J., & Friedjung, M. 2000, A&AS, 146, 407

Hurley, J.R., Pols, O.R., & Tout, C.A. 2000, MNRAS, 315, 543

Kahabka, P. 2004, A&A, in press

Mikołajewska, J. 2003, in Symbiotic Stars Probing Stellar Evolution, eds. R.L.M. Corradi, J. Mikołajewska, T. Mahoney, ASP Conf. Ser. vol. 303, 9

Mikołajewska, J. 2004, in preparation

Morgan, D.H., 1996, MNRAS, 279, 301

Munari, U., et al. 1992, A&AS, 93, 383

Mürset, U., Schild, H., & Vogel, M. 1996, A&A, 307, 516

Schönberner, D. 1989, in Planetary Nebulae, ed. S. Torres-Peimbert (Dordrecht: Kluwer), 463

N. Copernicus Astronomical Center, Bartycka 18, 00-716 Warsaw, Poland (mikolaj@camk.edu.pl).